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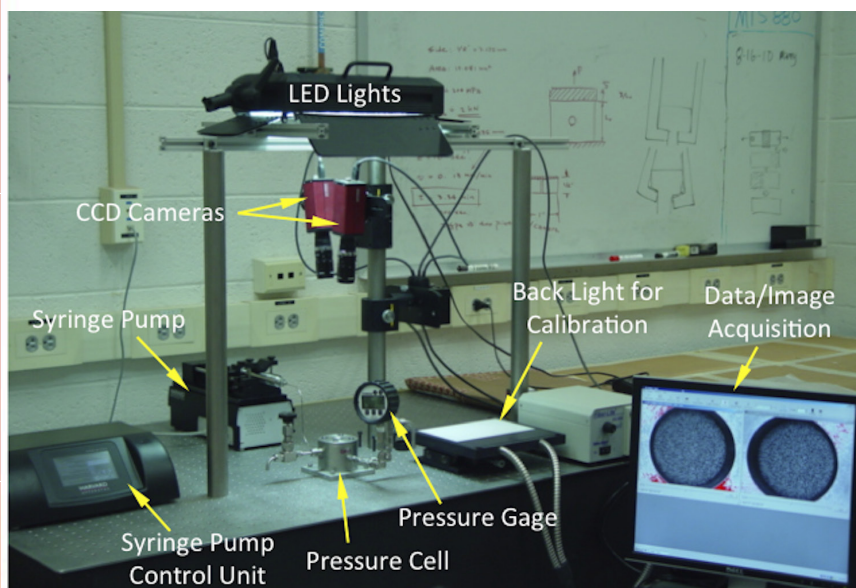
JOB SATISFACTION SURVEY

HEADS UP!

New apparatus conducts novel controlled-bulge test

Results benefit nuclear energy efforts

Materials Science in Radiation and Dynamics Extremes (MST-8) researchers have developed an apparatus for conducting a novel controlled-bulge test to measure the interfacial strength and toughness of thin monolithic nuclear reactor fuel plate.



The controlled-bulge test setup measures interfacial strength and toughness of thin nuclear reactor fuel foil, combining the miniature bulge test and the three-dimensional-DIC optical technique.

The work, by Cheng Liu, Manny Lovato, and Bill Blumenthal (all MST-8) supports the development of macroscopic interfacial bond strength methods for new aluminum-clad low enriched uranium (Zr/U-10%Mo) metal reactor fuel elements that are required for the reactor conversion project funded by Idaho National Laboratory through the Global Threat Reduction Fuel Development Program.

The novel "controlled-bulge test" was developed and demonstrated on a surrogate sample in the Materials Science Laboratory. The entire setup can fit into a hot-cell environment required for testing new and spent low-enriched uranium (LEU) fuel elements. A three-dimensional-DIC (three-dimensional digital image correlation) system has been successfully applied to the test. Calibration of the DIC system indicates that the uncertainty in determining the object profile/displacement is on the order of 0.03 pixels over an area of 1600×1200 pixels. All the quantities related to the determination of the bonding strength and toughness, are demonstrated to be obtainable from the DIC data.

Technical contact C. Liu

Celebrated annually in the United States on the fourth Thursday in November, the holiday of Thanksgiving was first observed in 1621 and continues to be an American tradition today. Thanksgiving means many things to different people but for most people, the holiday of Thanksgiving is synonymous with festive meals, parades, football, family and friends, and, of course, turkey. For many, it's also about spending time together, catching up and enjoying one another's company—in short taking time to be thankful for one's friends and family. And it's a great time to reflect upon the question "What are you most thankful for?"

Thanksgiving is an emotional holiday. People travel thousands of miles to be with people they only see once a year. And then discover once a year is way too often.

~Johnny Carson

In the work environment thankfulness tends to equate with job satisfaction. What makes you want to come to work each morning? A good job to provide financial support for your family? Exciting and important work? Close relationships with peers? Opportunities for promotion and career advancement? Service in the National Interest?



"In the work environment thankfulness tends to equate with job satisfaction ... Please take a few minutes over the break to use the job satisfaction self evaluation questionnaire to examine what gives you job satisfaction."

In what country is Thanksgiving ironically not celebrated? Turkey.

Please take a few minutes over the break to use the job satisfaction self evaluation questionnaire to examine what gives you job satisfaction (please see page 5). After scoring the survey, if you don't have a "good or great" job, think about what is most importantly lacking in your job satisfaction. Is it a life-balance issue? Is it elements of the tasks or job? Is it strained relationships? Is it a management issue?

As we prepare to wrap up the employee input process in our performance management system, please try and incorporate elements that will increase your job satisfaction into your WAGs. Studies have shown that in many cases, small tweaks in objectives and the methods used to accomplish them can make large differences in employee job satisfaction. Managers and employees alike should not get so wrapped up in "getting the job done", that we don't explore together how we can improve job satisfaction. But the process has to start with you, in being able to constructively articulate what needs improvement in your job satisfaction profile. Thanks for your attention and have a safe, secure and Happy Thanksgiving!

MST-7 Group Leader Ross Muenchausen



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MST researcher co-authors book chapter on nuclear energy

Chris Stanek (MST-8) is the lead co-author of a book chapter on nuclear energy for *Fundamentals of Materials for Energy and Environmental Sustainability*, to be published by Cambridge University Press in 2012.

In Chapter 13, "Nuclear energy: current and future schemes," Stanek and co-authors Robin Grimes (Imperial College London), Cetin Unal (Decision Applications, D-DO), Stuart Maloy (Civilian Nuclear Programs, SPO-CNP), and Sara Scott (Civilian Nuclear Programs, SPO-CNP) explore the materials science challenges that are unique to fission reactors. Nuclear fuel, the cladding, and structural materials must endure intensely high temperatures, moderate pressures, and an intense radiation field.

Reference: *Fundamentals of Materials for Energy and Environmental Sustainability*, Eds. David S. Ginley and David Cahen, Cambridge University Press for the Materials Research Society.

Technical contact: [Chris Stanek](#)

Nanotomography x-ray microscope brings new capability to MST-7

Researchers in Polymers and Coatings (MST-7) are gazing through a new microscope that offers the dual capabilities of ultra high-resolution x-ray radiography as well as three-dimensional tomography with nanoscale resolution. Housed in the Target Fabrication Facility, the Xradia UltraXRM-L200 microscope features a 1.2 kW rotating anode Cu x-ray source operating at 8 keV.

The Xradia UltraXRM-L200 microscope is well suited for the study of polymer foams, aerogels, high explosives, catalyst materials, damaged materials, particle dispersions, machined parts, thin films, and many other materials.

The Fresnel zone-plate lenses achieve a measured resolution of 150 nm (at 65- μ m field of view) and 50 nm (at 15- μ m field of view), a performance that is competitive with that of a large synchrotron. The instrument can be used in absorption contrast or Zernike phase contrast mode to increase edge contrast for materials with similar absorptions.

In just minutes, researchers can complete two-dimensional radiography using the high-flux source and Fresnel Zone plate lenses. Full three-dimensional computed tomography image acquisition can be performed non-destructively within a few hours to a few days, depending on the contrast of the sample.

continued on page 4

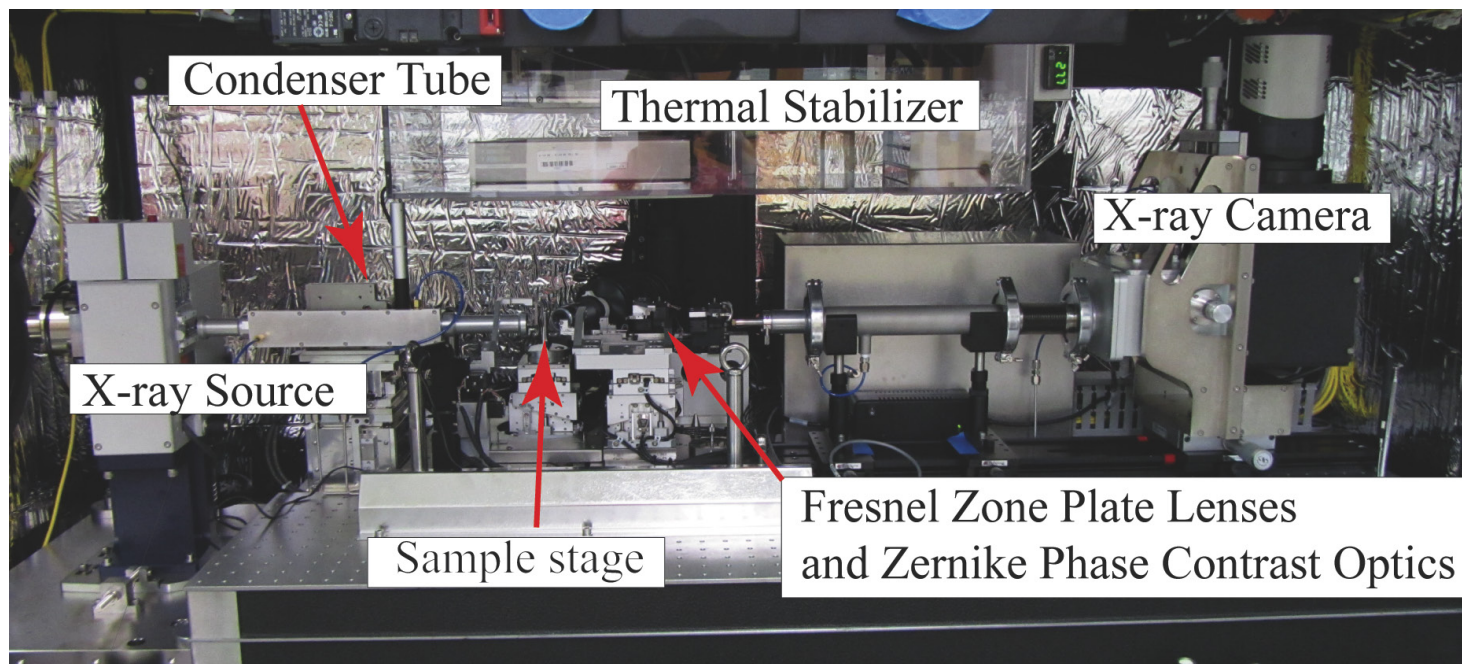
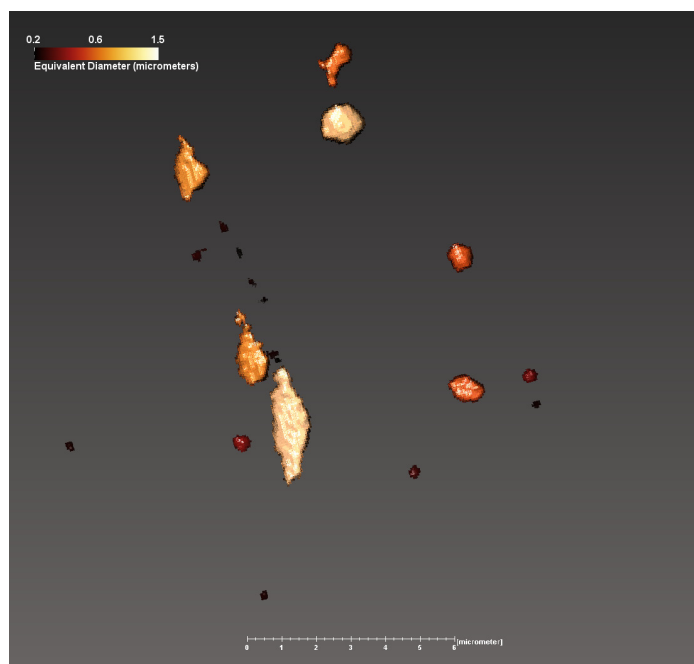


Image of interior of Xradia UltraXRM nano-CT instrument showing x-ray source, condenser tube, stage, optics, and detector system.

Nanotomography... The instrument operates at ambient pressure and is enclosed by a temperature controlling x-ray case. A piece of copper (provided by Ellen Cerreta (MST-8) and Darcie Dennis-Koller (Shock and Detonation Physics, WX-9), under the Laboratory Directed Research and Development program, LDRD) that was damaged in a gas gun experiment was the first sample analyzed. The sample was first imaged with the MicroCT instrument to locate the bulk of the voids, then machined down by Blaine Randolph (MST-7) to a 20 μm diameter post, and finally imaged with 50-nm resolution on the new Xradia UltraXRM-L200. The image shows the voids present within the sample, with the smallest void having an equivalent diameter of 200 nm.

Coupling this new instrument with the current MicroCT now allows for mesoscale three-dimensional imaging of samples with feature sizes of several millimeters down to the nanoscale. Funding for this purchase was provided by the Weapons Program, Enhanced Surveillance Program, LDRD, Inertial Confinement Fusion program, Campaign 2, Campaign 4, and the Joint Munitions Program. LANL program managers include Mary Hockaday, Tom Zocco, Bill Priedhorsky, Steve Batha, Rick Martineau, Kim Scott, and Eric Mas.

Technical contact: Brian M. Patterson

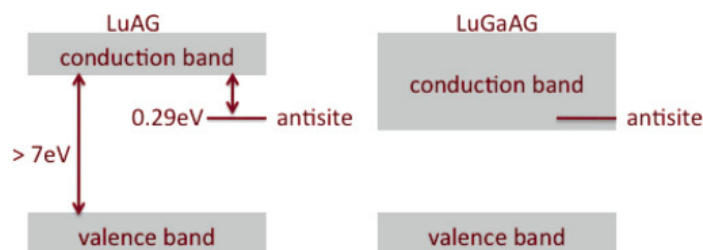


Three-dimensional image of voids within a piece of damaged Cu colored by equivalent diameter. The smallest voids have an equivalent diameter of 200 nm.

Celebrating service

Congratulations to the following MST Division employees celebrating service anniversaries this month:

Joseph Wermer, MST-16	15 years
Scott Richmond, MST-16	25 years



Schematic of the band structure of undoped LuAG (left-hand side), with a band gap of >7 eV and an antisite trap depth of 0.29 eV, compared to the proposed band shift due to Ga doping (right-hand side), where the antisite defect is no longer in the forbidden gap, but rather is enveloped by the CB.

Band-gap engineering for removing shallow traps in rare-earth $\text{Lu}_3\text{Al}_5\text{O}_{12}$ garnet scintillators using Ga³⁺ doping

In work appearing in *Phys. Rev. B.*, MST-8 researchers Chao Jiang, Blas Ueberuaga, David Anderson, Ken McClellan, and Chris Stanek, in collaboration with researchers at the University of Milano-Bicocca, Italy and the Institute of Physics, Czech Republic, propose an alternative defect management approach, one which relies on varying composition rather than synthesis route and is particularly applicable to shallow traps. The new approach could lead to scintillators with even better performance, allowing for band-gap engineering and predictive design of scintillator compositions.

Specifically, rather than employing doping to reduce the concentration of deleterious defects (as is done in defect engineering), the researchers propose to introduce dopants for the purpose of altering the electronic structure (band-gap engineering). They demonstrate the efficacy of this approach by showing how the electron trapping effect of isovalent cation antisite 46 defects in oxide scintillators $\text{Lu}_3\text{Al}_5\text{O}_{12}$ garnets (referred to as 47 LuAG) can be removed by an admixture of Ga³⁺.

Employing a combination of first-principles calculations and optical characterization experiments, the scientists explain the mechanism by which Ga³⁺ doping prevents the trapping of free carriers due to shallow traps in $\text{Lu}_3\text{Al}_5\text{O}_{12}$ garnet scintillators (where RE represents a 3+ rare-earth cation). Specifically, they confirm that Ga³⁺ doping does not reduce the defect concentration (defect engineering), but rather leads to shifts in the valence and conduction bands such that the energy level of shallow defects is no longer in the forbidden gap where electrons can be trapped (band-gap engineering).

Reference: "Band-gap engineering for removing shallow traps in rare-earth $\text{Lu}_3\text{Al}_5\text{O}_{12}$ garnet scintillators using Ga³⁺ doping," *Phys. Rev. B* **84**, 081102 (2011).

Technical contact: Chris Stanek

Job Satisfaction Survey

	YES	NO
1. I look forward to going to work on Monday morning.	<input type="checkbox"/>	<input type="checkbox"/>
2. I feel positive and up most of the time I am working.	<input type="checkbox"/>	<input type="checkbox"/>
3. I have energy at the end of each work day to attend to the people I care about.	<input type="checkbox"/>	<input type="checkbox"/>
4. I have energy at the end of each work day to engage in personal interests.	<input type="checkbox"/>	<input type="checkbox"/>
5. I have the time and energy in my life to read books that interest me.	<input type="checkbox"/>	<input type="checkbox"/>
6. Most interactions at work are positive.	<input type="checkbox"/>	<input type="checkbox"/>
7. I have good friends at work.	<input type="checkbox"/>	<input type="checkbox"/>
8. I feel valued and affirmed at work.	<input type="checkbox"/>	<input type="checkbox"/>
9. I feel recognized and appreciated at work.	<input type="checkbox"/>	<input type="checkbox"/>
10. Work is a real plus in my life.	<input type="checkbox"/>	<input type="checkbox"/>
11. I'm engaged in meaningful work.	<input type="checkbox"/>	<input type="checkbox"/>
12. I feel free to be who I am at work.	<input type="checkbox"/>	<input type="checkbox"/>
13. I feel free to do things the way I like at work.	<input type="checkbox"/>	<input type="checkbox"/>
14. My values fit with the organizational values.	<input type="checkbox"/>	<input type="checkbox"/>
15. I am aligned with the organizational mission.	<input type="checkbox"/>	<input type="checkbox"/>
16. I trust our leadership team.	<input type="checkbox"/>	<input type="checkbox"/>
17. I respect the work of my peers.	<input type="checkbox"/>	<input type="checkbox"/>
18. I have opportunities to learn what I want to learn.	<input type="checkbox"/>	<input type="checkbox"/>
19. I feel involved in decisions that affect our organizational community.	<input type="checkbox"/>	<input type="checkbox"/>
20. Creativity and innovation are supported.	<input type="checkbox"/>	<input type="checkbox"/>
21. I feel informed about what's going on.	<input type="checkbox"/>	<input type="checkbox"/>
22. I know what is expected of me at work.	<input type="checkbox"/>	<input type="checkbox"/>
23. I have the materials and equipment that I need in order to do my work right.	<input type="checkbox"/>	<input type="checkbox"/>
24. I have the opportunity to do what I do best every day at work.	<input type="checkbox"/>	<input type="checkbox"/>
25. My manager cares about me as a person.	<input type="checkbox"/>	<input type="checkbox"/>
26. I know someone at work who encourages my development.	<input type="checkbox"/>	<input type="checkbox"/>
27. My opinions count.	<input type="checkbox"/>	<input type="checkbox"/>
28. My coworkers are committed to doing quality work.	<input type="checkbox"/>	<input type="checkbox"/>
29. My manager reviews my progress.	<input type="checkbox"/>	<input type="checkbox"/>
30. I am fairly compensated.	<input type="checkbox"/>	<input type="checkbox"/>

Give yourself two points for each statement you answered positively. Use the following scale to evaluate your job.

50-60 points:	Great Job	40-49 points:	Good Job
30-39 points:	OK Job	20-29 points:	Bad Job
1-19 points:	Depressing Job		

HeadsUP!

Prep for winter

Driving in the winter has all of the hazards it does during the rest of the year—add wind chill, snow, ice, and darkness and we have even less margin for error. With days becoming ever shorter between now and the Winter Solstice, many of us will be commuting both ways in the dark. Cold and unpredictable weather will be the norm for the next few months. What should we be doing?

- If you have all-season tires on your car or light truck, ensure they are not more than 40-50% worn to provide adequate traction in serious snow. Even all-wheel drive vehicles are only as good as the

tread on their tires.

- Windshield wipers and all-season washing fluid must be ready to quickly clear filth, slush, and water from your field of view.
- Are all of your lights (headlights, running lights, tail lights, brake and turn signals) operating?
- Have you checked your heater and defroster?
- Do you have a small shovel and some sand and emergency supplies (flares, blanket, flashlight, emergency chains, cell phone) handy? Do you have a windshield scraper and snow remover and do you plan on clearing all your windows for safe visibility?